

COMPUTER.

**TIAC**



**seismic digital  
data processor**



**specifically designed for seismic applications**



# Texas Instruments Automatic Computer (TIAC)\*

- optimized for seismic processing
- low cost per computation
- high speed
- stored program flexibility
- higher throughput
- large drum bulk storage
- asynchronous tape units
- high-speed convolver

The economy of seismic data processing is a direct function of the speed and special systems features of the digital computer. The Texas Instruments Automatic Computer uses a highly versatile, general-purpose command structure in addition to special commands optimized for seismic processing.

TIAC, a stored program computer, offers speed approached only by more expensive computers. Memory cycle time is 1.5 microseconds or less. Addition and subtraction time is 3 microseconds, multiplying time is 6 microseconds and divide

time is only 12 microseconds. TIAC can efficiently process large amounts of data and is particularly suited to the digital treatment of signal enhancement problems. A special filter command provides extremely rapid solution to convolution-type computations. The memory section consists of a random-access core array of 4096 words, expandable to 32,768 words. Bulk storage utilizes a magnetic drum; capacity up to 1,048,576 words.

The asynchronous magnetic tape system, made possible by the data format, has many advantages for seismic data processing. The high-speed tape transports, operating asynchronously, facilitate control of a very fast input/output system with priority-interrupt capability. Off-line search for individual records by number aids in maximizing throughput. Partial records can be easily processed. Paper tape peripheral equipment affords octal or alpha-numeric input/output at slower speeds and direct communication between operator and the machine.

Reliability is enhanced by using parity checks on both memory and tapes. Alarm lights indicate malfunction or improper tape format. For reconstructing and editing of prime data, front panel switches permit operation with incorrect parity.

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## . . . proven capability

Through the addition of available optional equipment, the general- and special-purpose features of TIAC can be tailored to meet special individual requirements. Options include additional software, software assistance, on-line monitor, oscillograph, off-line field-tape search, loop-tape bulk storage and larger (or smaller) core memories.

**REEL-TAPE UNITS:** TIAC accepts up to four Reel-Tape Units, each with a 21-track head, 18 for data and one each for clock, block and parity bit. Packing density is 356 bits per inch, permitting a reading rate of 32,000 words per second (96,000 ch/sec) at 90 inches per second tape speed. The format is word organized and includes a timing word for precise definition of seismic events.

**MAGNETIC-DRUM UNIT:** a magnetic drum is provided for random access to data. Bulk storage is available to 1,048,576 words. Average random access time is 16.7 milliseconds.

**MAIN MEMORY:** a 4096 word core memory (expandable to 32,768 words) is used primarily for instruction storage since the drum serves for working data storage. Memory cycle time is 1.5 microseconds. In addition, to reduce effective cycle time, each memory access acquires two words. This

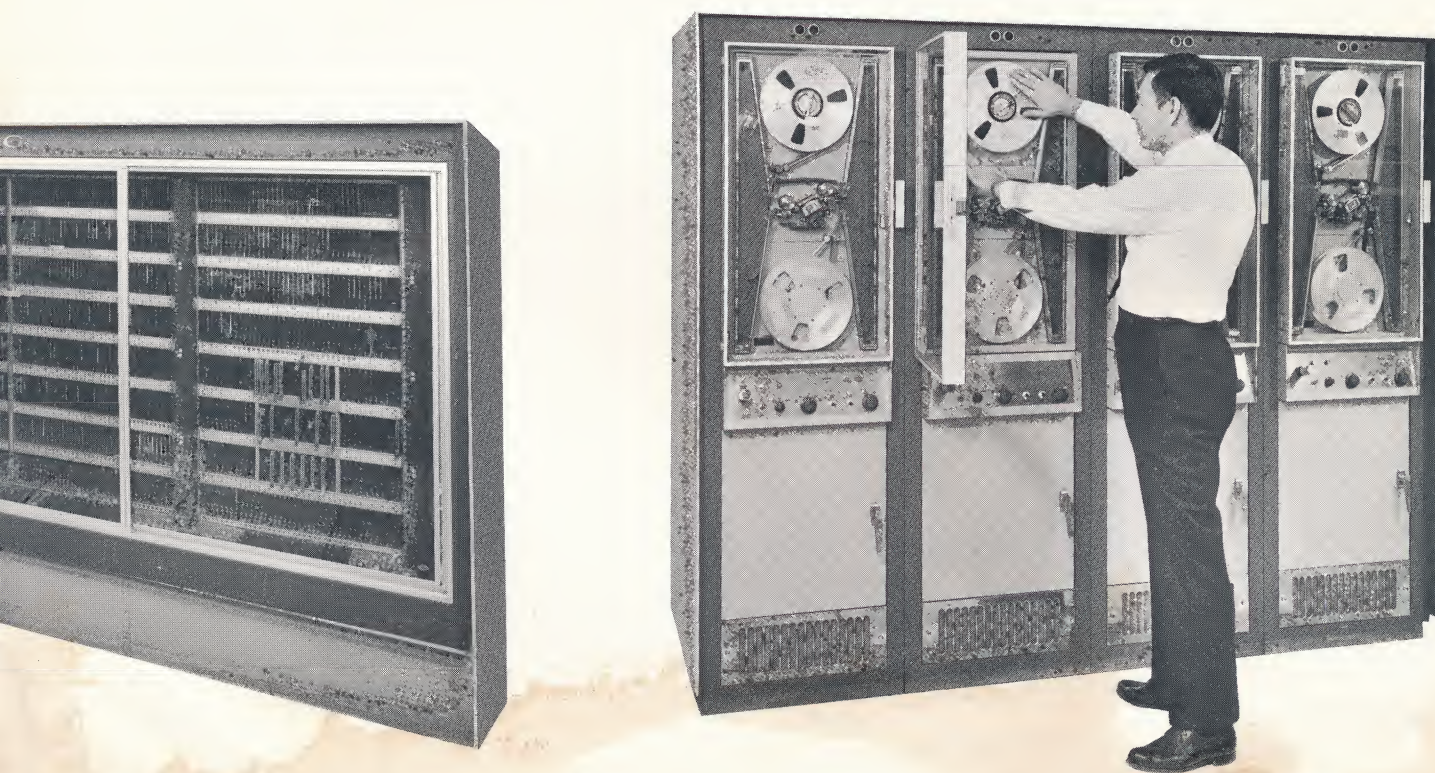
double-instruction acquisition significantly enhances the computation speed. In addition the double-word acquisition is used by the built-in double-precision instructions.

**ARITHMETIC UNIT:** has a double-length accumulator and a separate multiplier-quotient register, both having shifting capability. Three sets of index registers provide address and control functions.

**FILTER COMMAND:** provides extremely rapid solution to convolution type computations. In filtering or in any function using the convolution integral, the time to convolve two points is reduced from 15 microseconds to 1.6 microseconds.

**OPERATING CONSOLE:** displays the content of all registers of interest to programmer and operator. There are Break Point switches for program check-out and maintenance. These switches permit stopping the computer prior to execution of any instruction. Option switches provide additional flexibility for changing operating conditions.

**INPUT-OUTPUT EQUIPMENT:** TIAC is equipped with punched paper tape equipment having keyboard entry, hard copy output, and high-speed tape reading and punching capability.





# TIAC specifications

## Numerical System

Internal number system:	Binary
Binary bits per word:	18
Binary bits per instruction:	6 to 8
Instruction per word:	1
Instructions decoded:	75 approx
Arithmetic system:	Fixed point
Instruction type:	One address
Number range:	$-1 \geq n > 1$
Indexable instructions:	32

## Command Word Format

A TIAC command word contains 18 bits, numbered from 0 to 17, reading from left to right. Bits 0 through 5 are designated for Operation Code, specifying the operation to be performed. Bits 6 and 7 are Index Tags, specifying which index register is referenced. On some instructions, Bits 6 and 7 are part of the operation code. In other instructions, Bits 6 and 7 may specify reel tape unit, paper unit, etc. Bits 8 through 17 are the Address Field determining the memory address referenced.

## Arithmetic Unit

Arithmetic mode:	Parallel
Timing:	Asynchronous
Operation times (microseconds)	(Including Memory Access):
Add & Subtract:	3.0 maximum
Multiply:	6.0 maximum
Divide:	12.0 maximum

## Control Unit

Timing:	Asynchronous
Instructions per memory access:	2
Index registers:	3

## Core Storage Unit

Type, ferrite core:	Random access, linear selection
Capacity:	4096 words, double-word read, expandable to 32,768 words
Cycle time:	1.5 microseconds or less
Checking:	Parity check on readout

## Input-Output

Magnetic tape (up to 4 units):	32,000 words/second 96,000 alpha characters/second 192,000 octal characters/second
Flexowriter:	Keyboard, hard copy, read, punch
High-Speed Paper Tape Reader:	500 characters/second
High-Speed Paper Tape Punch:	110 characters/second
Software:	available software includes seismic routines, correlation and analysis routines, utility routines, sub-routines and diagnostic routines.

# optional equipment

The following equipment can be furnished as accessories or options to the standard TIAC. Other options, modifications or accessories furnished on request.

**Loop-Tape Unit:** a continuous loop of 1-inch tape with dynamic storage characteristics provided by a simultaneous read-write-compute feature. Up to 600,000 words are individually addressable as data are operated on and replaced during a single pass of the loop without transferring the data to core memory. Loops up to 150 feet are accommodated at speeds of 45 to 90 inches per second. After computation, data are transferred to a Reel-Tape Unit via the core memory.

**Tape Units for Operation with 1/2-inch Formats:** for input/output operation. Tape speed is 112.5 inches per second. High and low density selectable. Read after write error detection provided.

**On-Line Monitor of D-A Converted Loop- and Reel-Data:** separate console with 24-trace oscillograph for visual observation of results during processing.

**Off-Line Search of TIAC Tapes:** a control panel added to one of the four tape units provides off-line search capability of other data tapes during processing. This feature substantially reduces setup time; increases total throughput.

**Line Printer:** for printout at rates of 300 to 500 lines per minute.

**Paper Tape Reader:** one unit standard with TIAC. One additional unit may be accommodated.

**Paper Tape Punch:** one unit standard with TIAC. One additional unit may be accommodated.

## complete system designed for seismic use

TI digital seismic instrumentation is designed for the recording, processing and playback of seismic information. A product of eight years of research, the equipment represents the first unified "systems approach" to geophysical exploration.

The total system comprises completely compatible equipment—a field digital recording system, a companion digital computer, and an office playback system. A significant

feature of this specially designed instrumentation is that it utilizes a tape format designed for seismic exploration and data reduction. This is a key to its impressive success, its accuracy, its extremely high speed, and its effectiveness in finding oil.

Analog information from seismometers is amplified, multiplexed, digitized and recorded on the Digital Field System (DFS) in gapless format. The TIAC system ac-

cepts field data directly—no intermediate equipment is required. Data in process is stored on a magnetic drum—an economical method for reducing the size of core memory required. Processed tapes are converted back to analog form by the TIDAR\* (Texas Instruments Digital-Analog Read-out) system for interpretation.

The TI system is complete—designed for seismic use from field to finished section.

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INDUSTRIAL  
PRODUCTS  
GROUP



TEXAS INSTRUMENTS  
INCORPORATED

APPARATUS DIVISION  
P. O. BOX 66027 HOUSTON, TEXAS 77006